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#### MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

**FACULTY OF ENGINEERING, APPLIED SCIENCES AND TECHNOLOGY**

**DEPARTMENT: MINING AND MINERAL PROCESSING ENGINEERING**

**MODULE: SURFACE MINING**

**CODE: ENGP 223**

**SESSIONAL EXAMINATIONS**

**JUNE 2023**

**DURATION: 3 HOURS**

**EXAMINER: J. MUCHEMWA**

## INSTRUCTIONS

1. ***Section A*** *is compulsory*
2. *Answer any* ***THREE*** *questions from section B*
3. *Start a new question on a fresh page*
4. *Total marks 100*

***Additional material(s):***  *Calculator*

**SECTION A**

**Answer *all* questions *from this section.***

**QUESTION 1 (6 MARKS)**

(a) Why should you avoid loading explosives into a sub-drill?

A. Excessive confinement will lead to high peak particle velocity ground vibrations

B. Over-confinement could generate toxic fumes

C. Loading the sub-drill could result in poor high-wall stability

D. All of the above

(b) How does increasing the fragmentation of blasted rock decrease downstream costs related to it?

A. Increased fragmentation reduces shovel digging time

B. Increased fragmentation reduces the wear on haul equipment

C. Increased fragmentation increases the crushed throughput

D. All of the above

(c) What is a way to reduce the explosive energy adjacent to a high-wall on a production blast to ensure the integrity of the high-wall?

A. Reduce the total shot time, thereby reducing the amount of time the high-wall is subjected to vibrations

B. Use a controlled blasting technique (for example, pre-splitting)

C. Drill on an angle to keep the explosive energy away from the toe

D. All of the above

(d) What is the purpose of using a decked charge?

A. To lower the powder factor

B. To reduce the amount of explosives detonated per delay

C. To avoid loading a weak seam or to bypass a void in the rock

D. All of the above

(e) What are some general rules for designing the stemming for blast-holes?

A. Use crushed stone or drill cuttings as the stemming material

B. Stem at a ratio of from 0.5 to 1.3 times the amount of burden

C. Design stemming so that it contains explosive energy without generating fly-rock

D. All of the above

(f) What is the most important objective(s) of any blasting program?

A. Fragmentation

B. Lowering costs

C. Ensuring the safety of all workers in and around the blast site

D. a and c

**QUESTION 2**

A new iron ore deposit is to be worked by surface mining methods with 15 m benches using 150 mm diameter blast holes. Since the prevailing condition is dry rock, it has been decided to use bulk ANFO with emulsion cartridges as primer. Assume that the overall density of compacted ANFO and the primer as 0.85 g/cm3 and the powder factor of 0.6kg/m3

Find the appropriate burden and spacing for vertical holes and inclined boles.Assume that the drilled blast holes are in a staggered pattern forming equilateral triangles.

Assume fly rock factor to be Z = 1.25 and rock factor, A =11. **[19 marks]**

**SECTION B**

***Answer any three questions from this section.***

**QUESTION 3**

1. A nickel ore deposit is to be worked by open pit mining. The following values have been estimated for the deposit.

* Average grade = 1.5% Ni
* Mining cost/tonne ore = $5.00
* Beneficiation cost/tonne ore = $15.00
* Selling price = $6000.00/tonne metal
* Concentrator recovery = 85%
* Smelting and refinery recovery = 95%

What would be the waste stripping cost/tonne if the break-even stripping ratio is not to exceed 3.5?

N.B. Beneficiation costs are inclusive of concentrating, smelting, refining and administrative charges. **[15 marks]**

(b) Describe and explain the following stripping ratio methods, stating advantages and disadvantages of each method.

1. Increasing stripping ratio
2. Decreasing stripping ratio
3. Constant stripping ratio **[10 marks]**

**QUESTION 4**

The department of mining and mineral processing engineering at Manicaland State University of Applied Sciences (MSUAS) has acquired a gold claim which is amenable to surface mining. You are appointed the project coordinator for this mining project. Present to the board of the university convincing them to finance this project, pointing out all the stages of operation on this claim until closure.

**[25 marks]**

**QUESTION 5**

1. Briefly describe the following classes of surface mining methods.
2. Quarrying
3. Conical pit
4. Area strip mining
5. Solution mining
6. Placer mining **[15 marks]**
7. *Stripping ratio* and *cut-off grade* are key elements in pit design, define the term stripping ratio and discuss its importance. **[5 marks]**
8. Differentiate the terms Overall Stripping ratio and Break Even Stripping ratio. **[5 marks]**

**Question 6**

1. With aid of neatly drawn sketches, explain the following blasting and initiation patterns used in surface blasting operations.
2. Square pattern
3. Staggered pattern
4. Row-to-row pattern
5. V-cut pattern
6. Extended V-cut pattern **[15 marks]**
7. A surface mine blast design has the following parameters;

* Burden = 4.2 m
* Spacing = 5.2 m
* Bench height = 12.0 m
* High-wall angle = vertical
* Blast hole diameter = 229 mm
* Number of holes = 100
* Rock density =2.7 g/cm3
* Explosives = ANFO with a density of 0.85 g/cm3
* Swell factor = 60%

Calculate the;

1. Tonnage blasted **[5 marks]**
2. Powder factor  **[5 marks]**

**………..………END OF EXAM…………………**